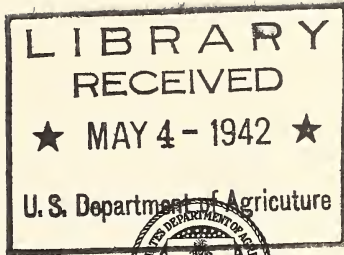


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UNITED STATES DEPARTMENT OF AGRICULTURE

Yearlong Grazing of Steers in the Northern Great Plains¹

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THE AREA AND ITS PROBLEMS

Beef production is the principal agricultural enterprise in the northern Great Plains (fig. 1). The maintenance of breeding herds and the production of feeder cattle are the most common phases of the beef-cattle industry in the area. In either case, a maximum use is made of grass and little use of grain.

Low precipitation and extreme temperatures, which are common to the greater part of the area, make crop production rather uncertain. Table 1 shows the monthly mean temperatures and precipitation during these experiments (1936-40) and the averages for 1912-40 at the Ardmore Field Station, Ardmore, S. Dak., where the experiments were conducted. Since this station is located in the southern part of the northern Great Plains, the results reported in this circular apply most aptly to the heavily shaded area in figure 1.

The average monthly mean temperatures, during the 4 years of these experiments, were as high as or higher than the average for the period 1912-40 except for November and January. In most instances the average monthly mean precipitation for the 4-year period varied considerably and did not correspond closely with the 28-year averages. In 5 of the 12 months, the average monthly precipitation during the 4-year period was below that for the 28-year period. The total annual

¹ Submitted for publication June 20, 1941.
² In cooperation with the Animal Husbandry Division of the Bureau.
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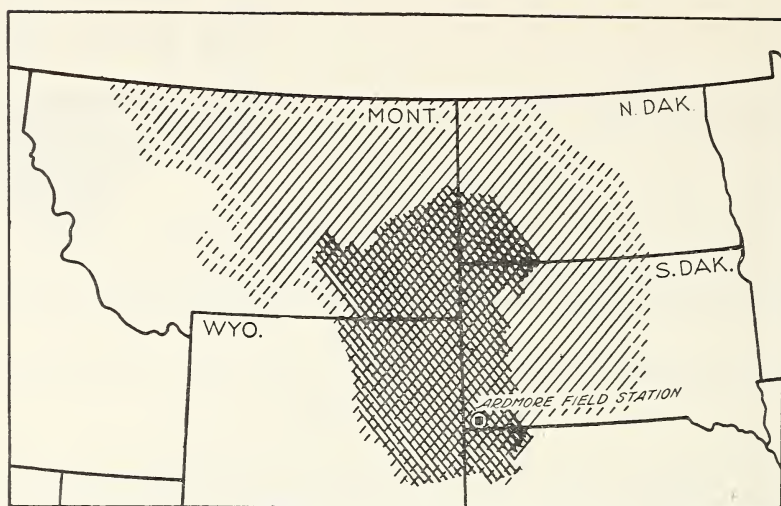


FIGURE 1.—Entire shaded area shows extent of northern Great Plains. Heavily shaded area represents the territory to which the results of this study apply.

precipitation increased during each succeeding year of the experiment, but the average annual total precipitation for the 4 years covered by the experiments was 1.64 inches less than that for the 28-year period.

Wintering experiments conducted at the Ardmore Field Station from 1923 to 1928 ⁴ and from 1928 to 1933 ⁵ showed that steers could be wintered satisfactorily in the feed lot on such home-grown feeds as (1) alfalfa when fed alone or in combination with oat straw and silage, (2) wheatgrass alone, (3) sorgo fodder alone, and (4) native range with small quantities of supplemental feeds.

TABLE 1.—Monthly mean temperatures and precipitation during the 4 years of the experiments, and averages for 1912–40, at the Ardmore Field Station, Ardmore, S. Dak.

Month	Mean temperature						Total precipitation					
	1936–37	1937–38	1938–39	1939–40	1936–40 average	1912–40 average	1936–37	1937–38	1938–39	1939–40	1936–40 average	1912–40 average
	°F.	°F.	°F.	°F.	°F.	°F.	Inches	Inches	Inches	Inches	Inches	Inches
September.....	64	65	65	¹ 67	63	61	1.07	0.37	2.36	¹ 2.23	1.51	1.08
October.....	47	49	53	¹ 53	50	47	.65	1.06	.23	¹ .51	.61	1.14
November.....	31	31	31	36	32	34	.92	.41	.92	.00	.56	.45
December.....	26	24	24	32	26	22	.20	.41	.24	.16	.25	.33
January.....	3	26	27	12	17	20	.57	.52	.83	.36	.57	.35
February.....	23	26	16	27	23	23	.43	.17	.52	.56	.42	.38
March.....	31	39	36	36	35	33	1.46	2.22	.62	.91	1.30	.82
April.....	46	46	47	45	46	44	.62	2.08	.59	5.36	2.16	2.01
May.....	60	55	61	57	58	55	2.77	3.07	3.22	.27	2.33	2.78
June.....	63	68	66	67	66	65	2.86	1.30	1.51	2.47	2.03	2.52
July.....	76	75	80	78	77	73	1.04	.98	.47	.76	.81	1.99
August.....	77	76	71	74	74	71	.43	.69	2.93	1.08	1.28	1.62
Total.....							13.02	13.28	14.44	14.67	13.83	15.47

¹ For the year 1940, as the 1939–40 experiment began about 5 weeks later than the previous ones and therefore continued into September and October 1940.

⁴ BLACK, W. H., and MATHEWS, O. R. WINTERING STEERS IN THE NORTH CENTRAL GREAT PLAINS SECTION. U. S. Dept. Agr. Tech. Bul. 192, 14 pp., illus. 1930.

⁵ — and MATHEWS, O. R. COMPARISON OF FEEDS FOR WINTERING STEERS IN THE NORTHERN GREAT PLAINS. U. S. Dept. Agr. Tech. Bul. 565, 10 pp., illus. 1937.

Summer grazing experiments conducted at Ardmore from 1919 to 1933 ⁶ showed that more than 7 acres of native range were required during the summer grazing season for steers 1 year or more old. These experiments also showed that overgrazing of the vegetation of the type used in the pastures resulted in severe losses in weight of the steers toward the end of the grazing season. Alternate grazing was found to be more satisfactory than continuous grazing when the rate of stocking was the same.

To throw further light on the problems of wintering and summer grazing of steers in the area, experiments were conducted from 1933 to 1936 ⁷ at the same station. These later experiments indicated that under the conditions at the Ardmore Field Station cattle may be wintered on the range satisfactorily with comparatively small quantities of grain or roughage, and significantly more economically than in the feed lot on a moderate ration of native roughage and cottonseed meal. The grazing studies showed that gains of steers on native range can be materially increased by the feeding of a grain supplement. The extra cost of the supplement was more than offset by the increased sales value of the steers resulting from the greater gains.

The present experiments were designed to determine whether approximately 20 acres of native range as used in the experiments were sufficient to carry steers from yearlings to 2-year-olds (a period of a full year), and whether alternate grazing of the range at 28-day intervals offered any advantages over continuous grazing.

EXPERIMENTAL PROCEDURE

The experiments were begun in the fall of 1936 and continued for 4 successive years. Each year 36 head of range-bred Hereford yearlings of Good to Choice quality were used (fig. 2). Steers only were used in all experiments except the fourth, when there was a shortage of these animals. In this experiment spayed heifers, as well as steers, were included. To allow the heifers time to recuperate from the spaying operation, the fourth experiment was begun about 5 weeks later than the preceding ones.

By random selection the cattle were divided into 2 groups of 18 each. After this division usually one or two shifts were made to equalize more nearly the weights of each group. One group was placed on pastures, having a total area of approximately 350 acres, to graze continuously for 1 year. The other group was grazed on pastures of equal total area but subdivided into 2 equal areas of 175 acres each, which were grazed alternately every 28 days. The native range at the Ardmore Field Station and vicinity consists of many species from widely separated families, but western wheatgrass (*Agropyron smithii* Rydb.), buffalo grass (*Buchloë dactyloides* (Nutt.) Engelm.), and blue grama (*Bouteloua gracilis* (H. B. K.) Lag.) pre-

⁶ BLACK, W. H., BAKER, A. L., CLARK, V. I., and MATHEWS, O. R. EFFECT OF DIFFERENT METHODS OF GRAZING ON NATIVE VEGETATION AND GAINS OF STEERS IN NORTHERN GREAT PLAINS. U. S. Dept. Agr. Tech. Bul. 547, 19 pp., illus. 1937.

⁷ BLACK, W. H., CLARK, V. I. EFFECT OF SUPPLEMENTING WINTER AND SUMMER RANGE ON GAINS OF STEERS IN THE NORTHERN GREAT PLAINS. U. S. Dept. Agr. Tech. Bul. 628, 16 pp., illus. 1938.

dominate (fig. 3). Although these three grasses dominate the vegetation of this section as a whole, other species are present and some almost completely occupy small areas, plains bluegrass (*Poa arida* Vasey), for instance, furnishing considerable grazing during some periods.⁸ The actual rate of stocking for each group was 19.44 acres per head. The total grazing period for each year consisted of a

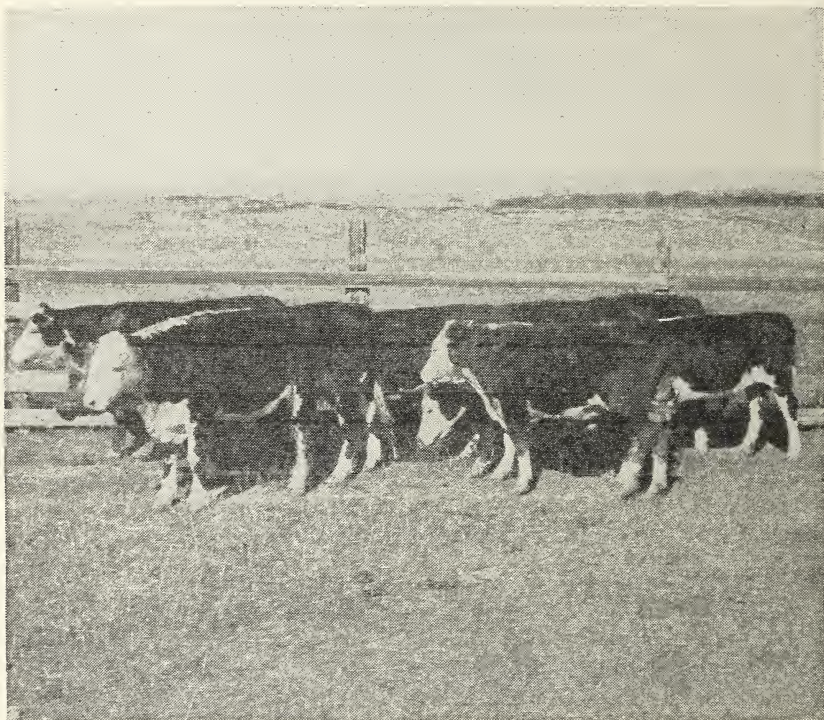


FIGURE 2.—Type of cattle used in the experiments.

fall and winter period of 224 days and a spring and summer period of 140 days. At the close of the year's grazing the cattle were sold on the Omaha market.

Weighings were made on 3 successive days at the outset and close of the experiments and at 28-day intervals. Only during inclement weather when vegetation was sparse or snow-covered was it necessary to supplement the range with small quantities of concentrates and roughage. Salt was available in block form at all times. By the use of a gas engine, water was pumped daily into tanks on each side of the fence which separated the pastures. The animals had access to open sheds at all times.

⁸ See footnote 6.



FIGURE 3.—Typical native range at the Ardmore Field Station.

EXPERIMENTAL RESULTS

1936-37 EXPERIMENT

The results of the first year's experiment are summarized in table 2. The average weights of the cattle by 28-day periods are shown graphically in figure 4.

As both groups of steers lost considerably in weight from the latter part of October to the first part of February, the range was supplemented intermittently from December 4 to April 7 with small quantities of cottonseed cake, alfalfa hay, and oat straw. Both groups of steers lost about the same weight during the winter months. The continuously grazed group averaged 23 pounds greater total gain per head during the spring and summer grazing season than the group grazed alternately. For the entire experiment the difference in average gain, although in favor of the continuously grazed group, was not significant.

Both groups of steers produced carcasses grading about average Good. The difference in carcass grade was not significant but was slightly in favor of the continuously grazed group. Both groups

sold on the hoof at the same price per hundredweight. This was the only year of these experiments in which the cattle carried sufficient finish to be in demand for slaughter purposes.

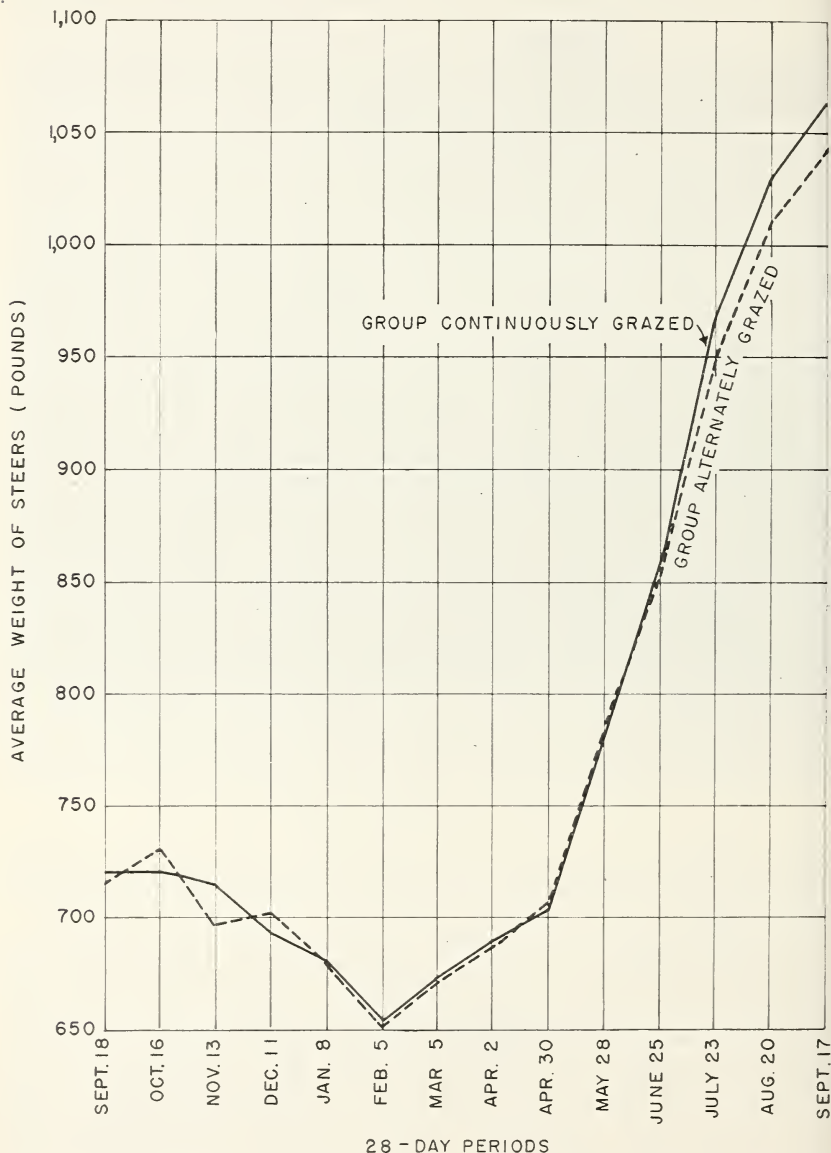


FIGURE 4.—Average weights of steers by 28-day periods, first experiment, 1936-37.

Observations of the condition of the two pastures showed a slight difference, at the end of the experiment, in favor of the one alternately grazed. However, in this experiment as well as the later ones, neither pasture had the appearance of being overgrazed.

TABLE 2.—*Summary of results of the first experiment in the 364 days from Sept. 18, 1936, to Sept. 17, 1937, inclusive*

[18 steers per group; 19.44 acres per steer]

Item	Group 1, continuously grazed	Group 2, alternately grazed
Fall and winter period (224 days):		
Average initial weight per steer.....pounds	719	715
Average final weight per steer.....do	705	706
Average total loss per steer.....do	14	9
Supplemental feeds consumed per steer:		
Cottonseed cake.....do	92	92
Alfalfa hay.....do	210	212
Oat straw.....do	105	105
Value of feeds and range per steer ¹dollars	10.78	10.79
Spring and summer grazing period (140 days):		
Average initial weight per steer.....pounds	705	706
Average final weight per steer.....do	1,065	1,043
Average total gain per steer.....do	360	337
Value of range per steer.....dollars	4.62	4.62
Annual period (364 days):		
Average yearly gain per steer.....pounds	346	328
Average daily gain per steer.....do	0.95	0.90
Value of feed and range per steer ²dollars	15.49	15.51
Value of feed and range per 100 pounds of gain.....do	4.48	4.73
Average sales weight per steer.....pounds	962	934
Average shrinkage per steer.....do	103	109
Average hot-carcass weight.....do	523	510
Average sales price per 100 pounds.....dollars	9.75	9.75
Average dressing percentage.....percent	53.2	53.5
Average grade of carcass ³score	74	73

¹ At the following prices: Range, \$0.033 per head daily; cottonseed cake, \$36 per ton; alfalfa hay, \$12 per ton; oat straw, \$9 per ton; salt, \$26 per ton.⁴

² Includes \$0.09 charge for salt in group 1 and \$0.10 in group 2.

³ 90.00-80.01 = Choice grade; 80.00-70.01 = Good grade; 70.00-60.01 = Medium grade.

1937-38 EXPERIMENT

The summary of the 1937-38 experiment is shown in table 3. The periodic average weights are shown graphically in figure 5. During the fall and early winter period the two groups made slight gains, but there was a noticeable decrease in weight from the middle of January to the first of April, when grazing conditions were poor. It therefore became advisable to supplement the range with small quantities of feed, but these were considerably less than the quantities fed during the previous year. In the second year, the total value of supplements was only \$0.45 per steer, as compared with about \$3.40 for the first year's experiment. When supplements were used in any year, the same kinds and quantities were supplied to each group of cattle. The fall and winter gains were slightly in favor of the group using the alternately grazed range.

During the spring and summer grazing period the alternately grazed group gained more than the one kept on the same range continuously. For the entire period of 364 days the alternately grazed group gained 26 pounds per steer more than the other group. Based on Snedecor's ⁹ analysis of variance, this difference was significant, *P* being less than 0.05. The spring and summer and the yearly gains for both groups were somewhat less than those of the previous year. During the fall and winter period, however, the animals used in

⁹ SNEDECOR, GEORGE W. STATISTICAL METHODS. Ed. 3, 422 pp., illus. Ames, Iowa. 1940.

the second experiment gained in weight, whereas those in the first experiment lost slightly.

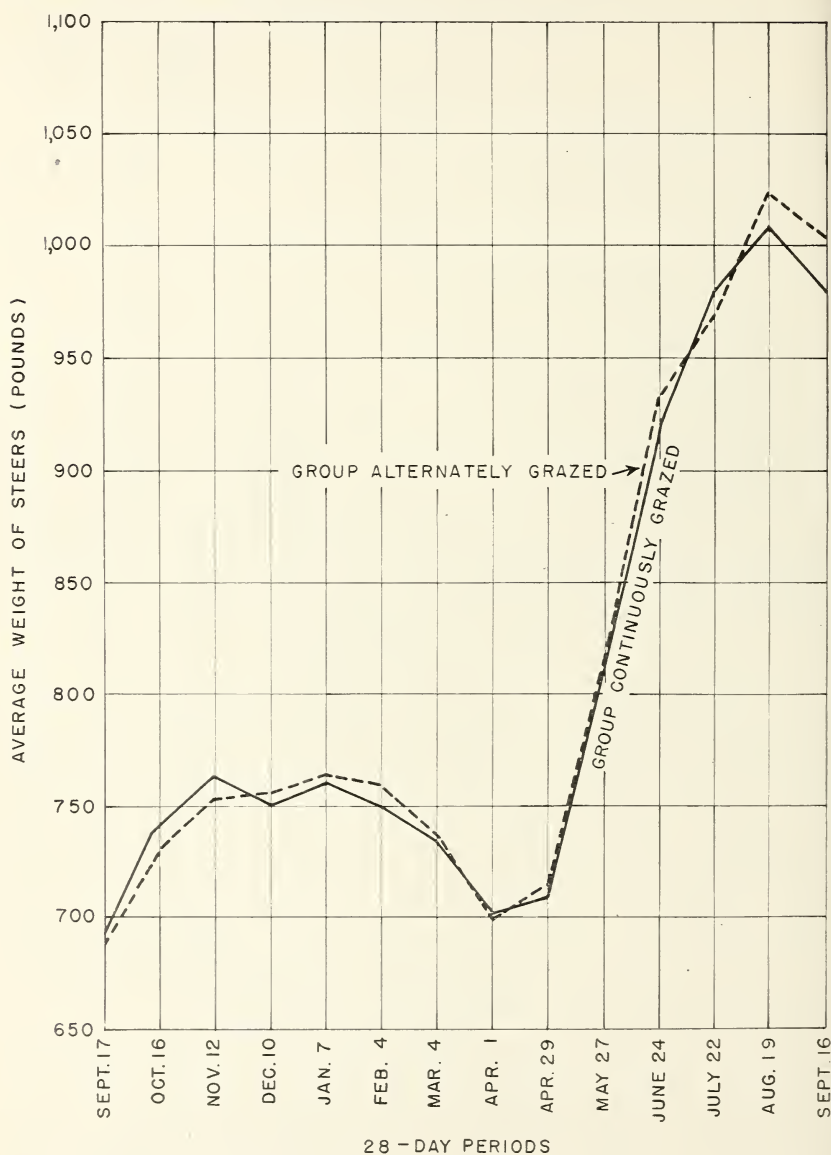


FIGURE 5.—Average weights of steers by 28-day periods, second experiment, 1937-38.

The steers did not have sufficient finish to be attractive as slaughter animals. Both groups sold at the same price per hundredweight, but the alternately grazed group graded slightly higher than the continuously grazed group at the conclusion of the experiment.

The observed stand of the two pastures was similar to that of the previous year. Again the alternately grazed pasture was slightly better than the one continuously grazed.

TABLE 3.—*Summary of results of the second experiment in the 364 days from Sept. 17, 1937, to Sept. 16, 1938, inclusive*

[18 steers per group; 19.44 acres per steer]

Item	Group 1, continuously grazed	Group 2, alternately grazed
Fall and winter period (224 days):		
Average initial weight per steer.....pounds..	689	687
Average final weight per steer.....do.....	709	714
Average total gain per steer.....do.....	20	27
Supplemental feeds consumed per steer:		
Barley (ground).....do.....	8	8
Alfalfa hay.....do.....	35	35
Oat straw.....do.....	35	35
Value of feeds and range per steer ¹dollars..	7.84	7.84
Spring and summer grazing period (140 days):		
Average initial weight per steer.....pounds..	709	714
Average final weight per steer.....do.....	981	1,005
Average total gain per steer.....do.....	272	291
Value of range per steer.....dollars..	4.62	4.62
Annual period (364 days):		
Average yearly gain per steer.....pounds..	292	318
Average daily gain per steer.....do.....	0.80	0.87
Value of feed and range per steer ²dollars..	12.49	12.49
Value of feed and range per 100 pounds of gain.....do.....	4.28	3.93
Average sales weight per steer.....pounds..	876	884
Average sales price per 100 pounds.....dollars..	7.90	7.90
Average shrinkage per steer.....pounds..	105	121

¹ At the following prices: Range, \$0.033 per head daily; barley, \$20 per ton; alfalfa hay, \$12 per ton; oat straw, \$9 per ton; salt, \$26 per ton.

² Includes \$0.03 charge for salt in each of the 2 groups.

1938-39 EXPERIMENT

A summary of the results of the third experiment is shown in table 4. Average weights of steers by 28-day periods are illustrated graphically in figure 6.

During the fall and early winter period the steers made essentially the same gains as those of the steers in the 1937-38 experiment. The gains made from the middle of September to December 9 slightly offset the losses during the succeeding 112 days. The arrival of early spring vegetation resulted in weight increases, which continued until the end of the spring and summer grazing season, as in the 1936-37 experiment. However, there was a slight decrease in rate of gains during the last 28-day period. In the 1937-38 test, during the last 28-day period, there was an average loss in weight of about 25 pounds per head for the two steer groups.

The yearly steer gains for each group in the 1938-39 experiment were similar to those made by the corresponding groups in the 1937-38 test. The steers in each group finished the test at essentially the same weight, there being only 3 pounds difference in favor of the steers using the alternately grazed range. The steers did not carry sufficient finish to be in demand as slaughter cattle and hence were sold as heavy feeders, both groups selling at the same price per pound.

At the end of the experiment, the continuously grazed pasture was observed to have an appreciably better stand of vegetation than the

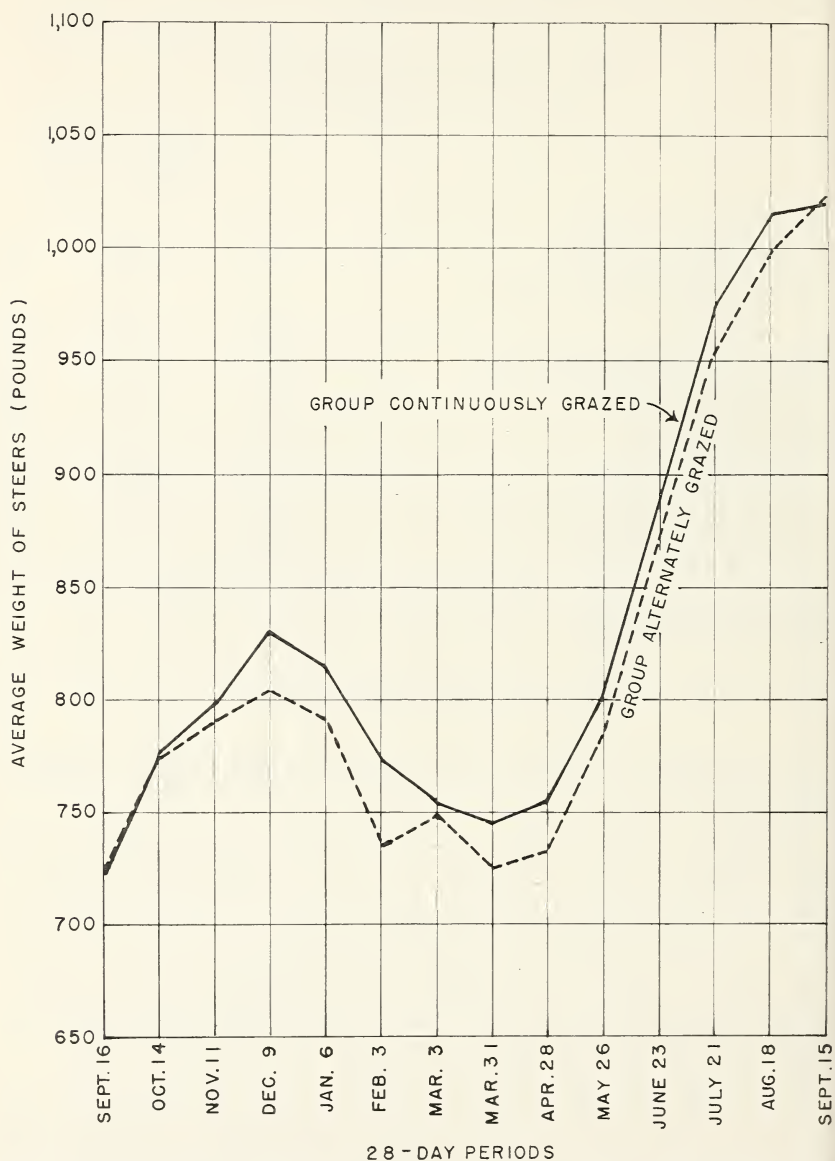


FIGURE 6.—Average weights of steers by 28-day periods, third experiment, 1938-39.

one alternately grazed. This result is contrary to those obtained during the previous 2 years.

TABLE 4.—*Summary of results of the third experiment in the 364 days from Sept. 16, 1938, to Sept. 15, 1939, inclusive*

[18 steers per group; 19.44 acres per steer]

Item	Group 1, continuously grazed	Group 2, alternately grazed
Fall and winter period (224 days):		
Average initial weight per steer..... pounds	719	720
Average final weight per steer..... do	755	734
Average total gain per steer..... do	36	14
Supplemental feeds consumed per steer:		
Barley (ground)..... do	9	9
Alfalfa hay..... do	367	367
Value of feeds and range per steer ¹ dollars	9.68	9.68
Spring and summer grazing period (140 days):		
Average initial weight per steer..... pounds	755	734
Average final weight per steer..... do	1,020	1,023
Average total gain per steer..... do	265	289
Value of range per steer..... dollars	4.62	4.62
Annual period (364 days):		
Average yearly gain per steer..... pounds	301	303
Average daily gain per steer..... do	0.83	0.83
Value of feed and range per steer ² dollars	14.33	14.33
Value of feed and range per 100 pounds of gain..... do	4.76	4.73
Average sales weight per steer..... pounds	896	899
Average sales price per 100 pounds..... dollars	8.75	8.75
Average shrinkage per steer..... pounds	124	124

¹ At the following prices: Range, \$0.033 per head daily; barley, \$20 per ton; alfalfa, \$12 per ton; salt, \$26 per ton.

² Includes \$0.03 charge for salt in each of the 2 groups.

1939-40 EXPERIMENT

A summary of the results of the fourth experiment is shown in table 5. Figure 7 shows the average weights of steers by 28-day periods, except for the January period, when the weighing was somewhat late owing to adverse weather conditions. During the fall and winter period both groups made much greater gains than those of any previous experiment. This result was due to the fact that this grazing period began about a month later in the fall and therefore extended later in the early growing season, when the grass makes its most rapid growth. As in previous years it was necessary to supplement the range with available feeds when vegetation was either very sparse or covered with snow. The expense for supplemental feed was considerably lower than for the first and third years.

During the 140-day spring and summer period, the group on the alternately grazed area gained 26 pounds more per head than the group on the continuously grazed area. During the entire period of 364 days, the group on the continuously grazed area gained 14 pounds per head more than the other group. This difference, however, was not significant. Both groups sold as feeders at essentially the same price per hundredweight.

At the end of the experiment, there was no difference in the observed appearance of the continuously grazed and alternately grazed pastures. Furthermore, after 4 consecutive years of use, these pastures showed no ill effects of the rate of stocking employed.

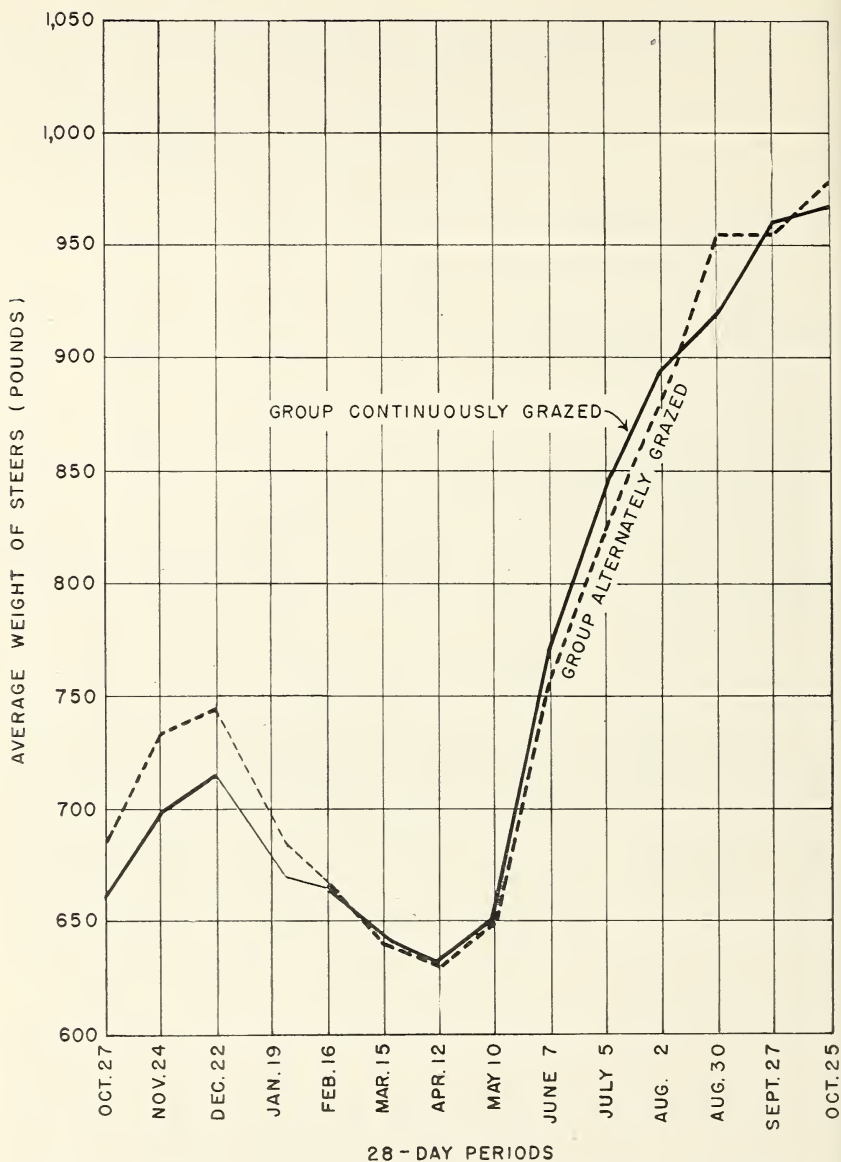


FIGURE 7.—Average weights of steers by 28-day periods, fourth experiment, 1939-40.

TABLE 5.—*Summary of results of fourth experiment in the 364 days from Oct. 27, 1939, to Oct. 25, 1940, inclusive*[18 cattle per group;¹ 19.44 acres per animal]

Item	Group 1, continuously grazed	Group 2, alternately grazed
Fall and winter period (224 days):		
Average initial weight per head..... pounds *	662	686
Average final weight per head..... do.....	772	756
Average total gain per head..... do.....	110	70
Supplemental feeds consumed per head:		
Corn (shelled)..... do.....	16	16
Alfalfa hay..... do.....	110	110
Oat straw..... do.....	50	50
Value of feeds and range per head ² dollars	8. 45	8. 45
Spring and summer grazing period (140 days):		
Average initial weight per head..... pounds.....	772	756
Average final weight per head..... do.....	968	978
Average total gain per head..... do.....	196	222
Value of range per head..... dollars	4. 62	4. 62
Annual period (364 days):		
Average yearly gain per head..... pounds.....	306	292
Average daily gain per head..... do.....	0. 84	0. 80
Value of feed and range per head ³ dollars.....	13. 07	13. 07
Value of feed and range per 100 pounds of gain..... do.....	4. 27	4. 48
Average sales weight per head..... pounds.....	863	875
Average sales price per 100 pounds..... dollars.....	9. 48	9. 50
Average shrinkage per head..... pounds.....	105	103

¹ 13 steers and 5 spayed heifers in each of the 2 groups.² At the following prices: Range, \$0.033 per head daily; shelled corn, \$22 per ton; alfalfa hay, \$12 per ton; oat straw, \$9 per ton; salt, \$26 per ton.³ Includes \$0.031 charge for salt in group 1 and \$0.033 for group 2.

AVERAGE RESULTS

The average results of the four experiments are summarized in table 6.

In average winter gains there was a difference of only 12 pounds per head in favor of the steers kept on the same range continuously, and, as is usually the case, the cattle making the greater winter gains made the smaller summer gains. The cattle on the alternately grazed areas made 10 pounds more gain per head during the spring and summer period. However, there was a difference of but 2 pounds in total yearly gains in favor of the group grazing the same area continuously throughout the test. This difference was obviously not significant. Group 1 made greater yearly gains during the first and fourth experiments; group 2, during the second and third. In only 1 year (1936-37) were the cattle carrying sufficient finish at the close of the experiment to be in demand for slaughter. In the other three experiments the cattle, although in good flesh, were considered as feeders. This result conforms with the usual tendency for young cattle on unsupplemented range to grow rather than to fatten.

Figure 8 shows that, on the average for the 4-year period, the cattle gained in weight for about the first 60 days. They tended to lose weight rather uniformly from the beginning of winter until the grass

made a new growth in the spring (about the middle of April). From then on until the latter part of September the average cattle gains

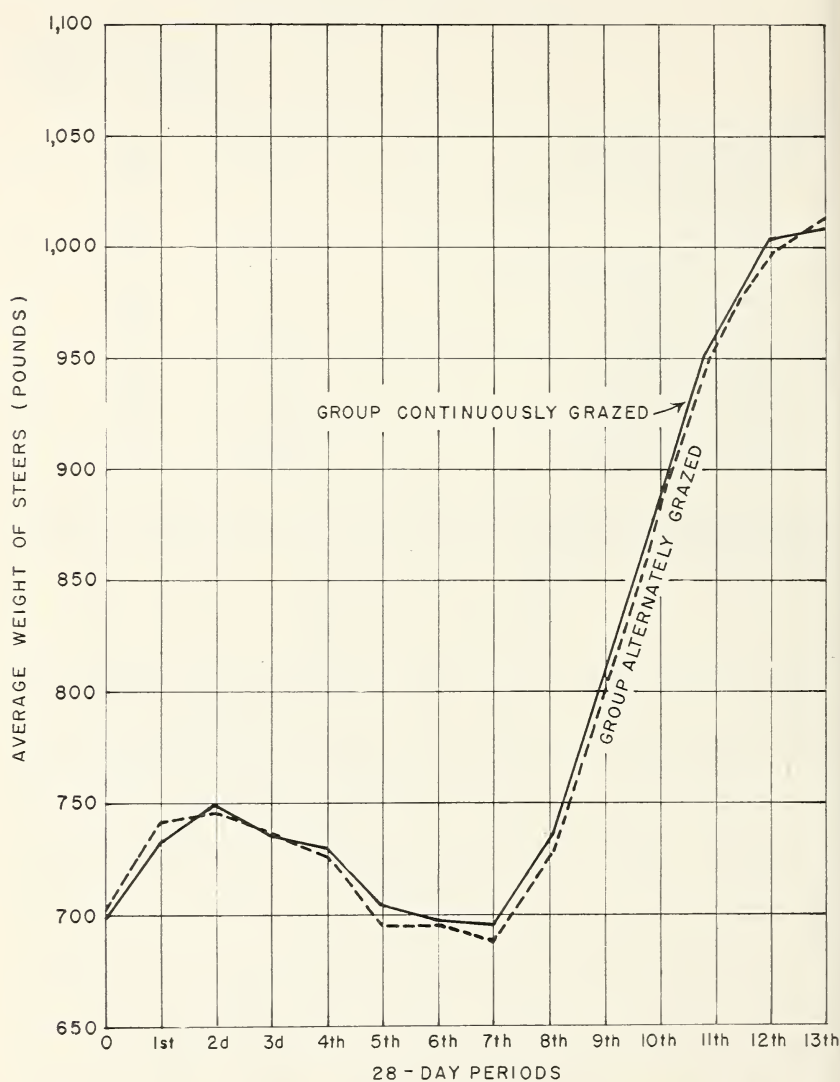


FIGURE 8.—Average weights of steers by 28-day periods (average of 4 experiments).

were very uniform. There was no significant difference in the gains between the cattle using the same range continuously and similar cattle using alternately grazed range.

TABLE 6.—*Summary of results of the 4 experiments, 1936-40*

[18 cattle per group per year; 19.44 acres per animal]

Item		Group 1, continuously grazed	Group 2, alternately grazed
Fall and winter period (224 days):			
Average initial weight per head.....	pounds	697	702
Average final weight per head.....	do.	735	728
Average total gain per head.....	do.	38	26
Value of feed per head.....	dollars	1.80	1.80
Value of range (224 days).....	do.	7.39	7.39
Spring and summer grazing period (140 days):			
Average initial weight per head.....	pounds	735	728
Average final weight per head.....	do.	1,009	1,012
Average total gain per head.....	do.	274	284
Value of range per head.....	dollars	4.62	4.62
Annual period (364 days):			
Average yearly gain per head.....	pounds	312	310
Average daily gain per head.....	do.	0.86	0.85
Value of feed and range per head ¹	dollars	13.81	13.81
Value of feed and range per 100 pounds of gain.....	do.	4.43	4.45
Average sales weight per head.....	pounds	899	898
Average sales price per head per 100 pounds.....	dollars	8.97	8.97
Average shrinkage per head.....	pounds	110	114

¹ Does not include production costs such as those for equipment, labor, and interest.

Under the conditions of the 4-year experiment about 20 acres of native range, supplemented with slightly less than \$2 worth of winter feed, produced a little more than 300 pounds of yearly gain on feeder cattle approximately 16 months of age at the beginning of the experiment. The 4-year average cost of gains amounted to about \$0.045 per pound. The range (valued at \$0.033 per head per day) accounted for approximately 87 percent of the cost.

As the average annual precipitation during the 4-year experiment was only slightly below that for the 29-year period 1912-40, the yearly gains during the experiments appear to be about what might be expected over a long period.

SUMMARY AND CONCLUSIONS

Experiments were carried on at the Ardmore Field Station, Ardmore, S. Dak., for 4 successive years, beginning in the fall of 1936, to determine whether about 20 acres of native range were sufficient to carry a yearling steer for 1 year and whether alternate grazing would have any advantage over continuous grazing. Two areas of 350 acres each were used, one of which was grazed continuously and the other divided into two equal areas of 175 acres each and the steers changed from one half to the other every 28 days. The rate of stocking was 19.44 acres per head, or 18 animals for each of the 350-acre tracts. The animals used were yearlings, approximately 16 months of age at the beginning of each experiment, and were grazed for 1 full year.

The vegetation was the native range, which includes a large number of species from widely separated families. The vegetation is dominated, however, by western wheatgrass (*Agropyron smithii*), buffalo grass (*Buchloë dactyloides*), and blue grama grass (*Bouteloua gracilis*). During the period covered by the study, precipitation was favorable for vegetative growth.

Results indicate that approximately 20 acres of native range as used in these experiments were sufficient to carry steers from yearlings to 2-year-olds. The use of supplemental feed was necessary only during very severe weather or when the range was snow covered. With yearling cattle the native range, as handled in these experiments, appeared to be more suitable for the production of feeders than slaughter cattle, as in only 1 year out of 4 did the cattle have sufficient finish to be in demand for immediate slaughter. However, there is more of a tendency for yearlings to devote their feed to muscle and skeletal development rather than to fat formation, as is the case with older steers.

There was no advantage in alternate grazing over continuous grazing as measured by steer gains. Also, after 4 years of grazing there was no difference in the appearance of the vegetation on the two pastures nor was there any indication that the pastures had been overgrazed.

Under the conditions of these experiments the alternately grazed area required an additional mile of fencing, which would necessitate sufficiently greater returns over those from the continuously grazed area with less fencing to compensate for the increased investment in equipment.

